

# Multiparent populations & R/qtl2

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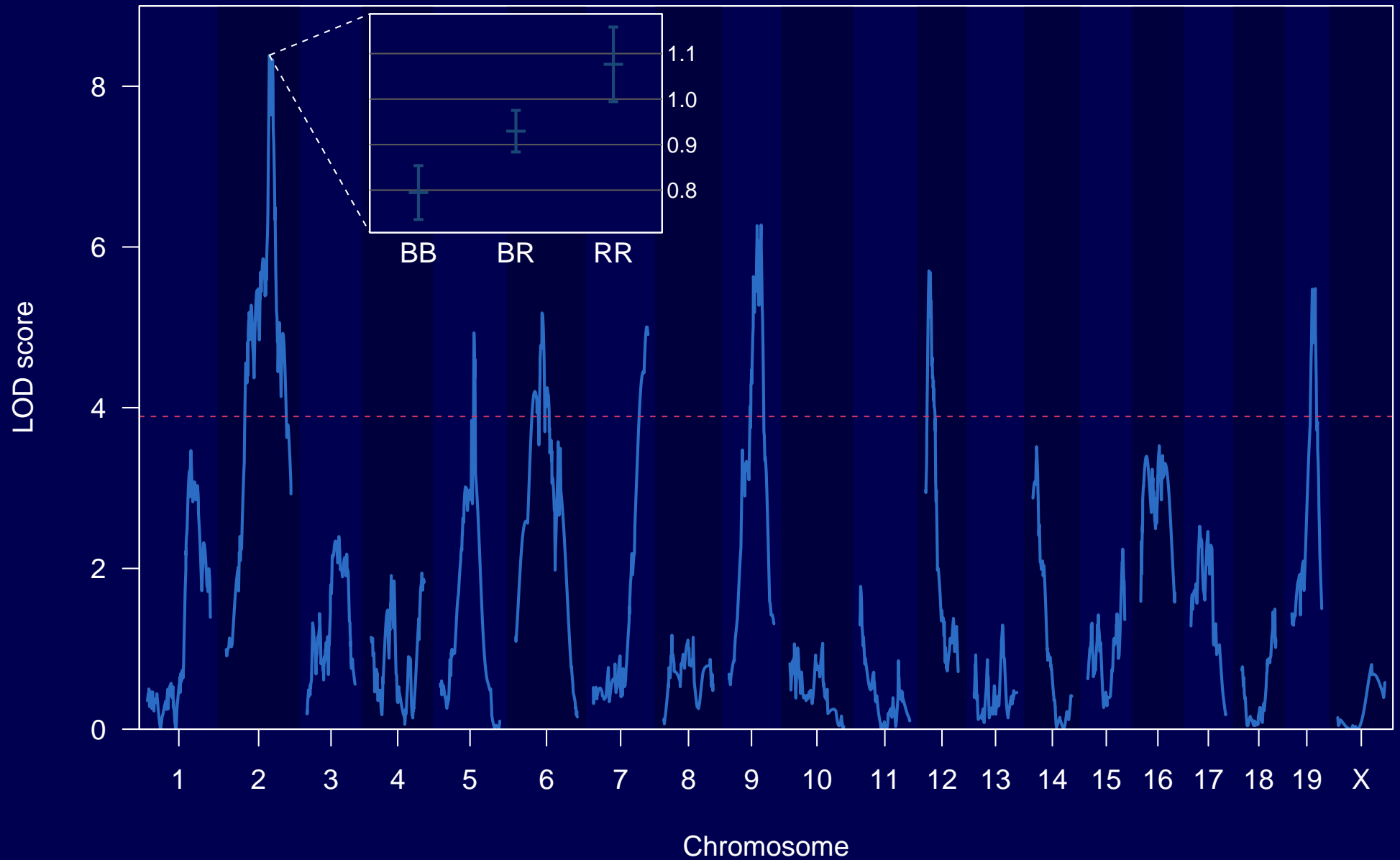
[kbroman.org/qtl2](http://kbroman.org/qtl2)

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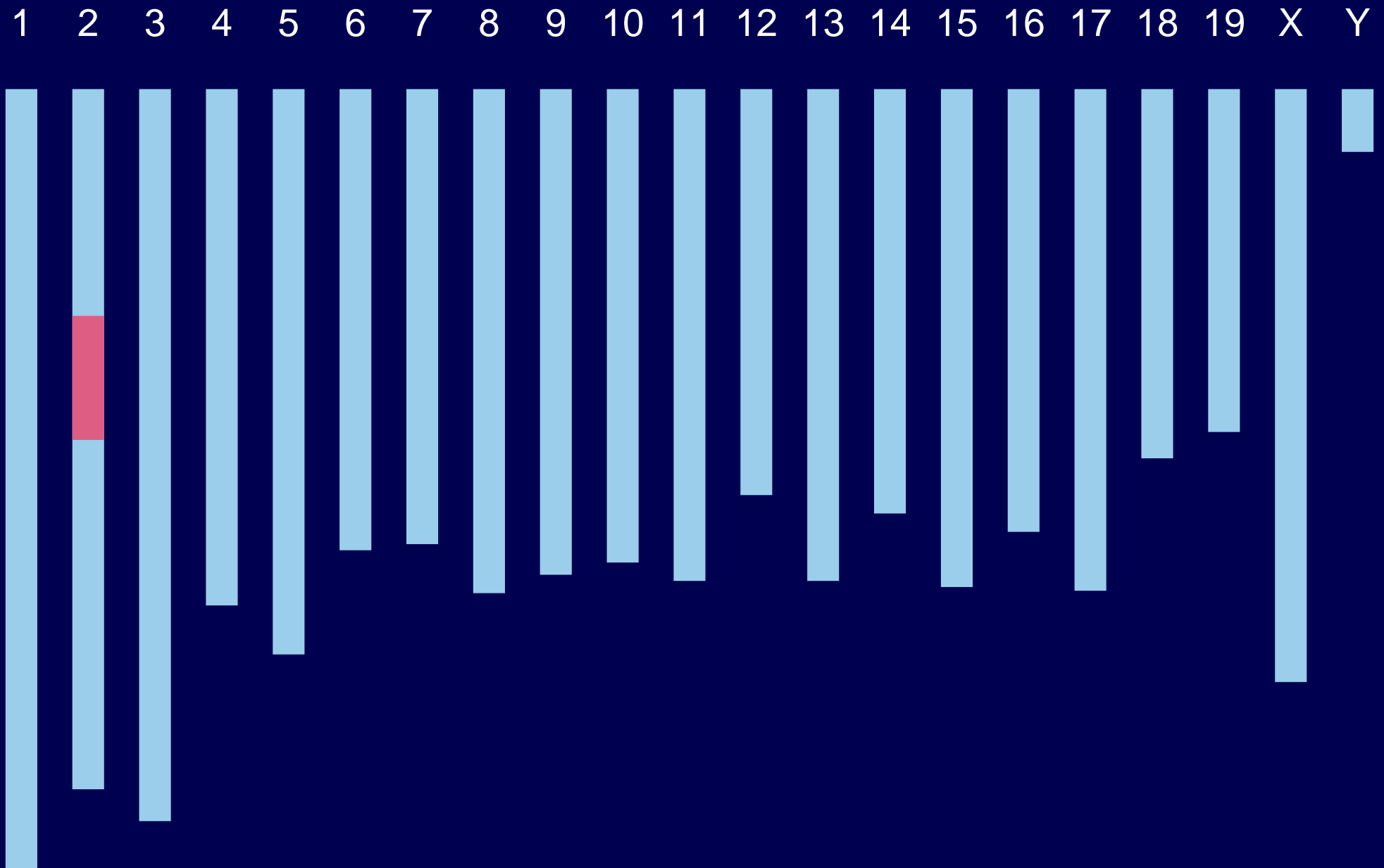
[github.com/kbroman](https://github.com/kbroman)

@kwbroman

# QTL mapping



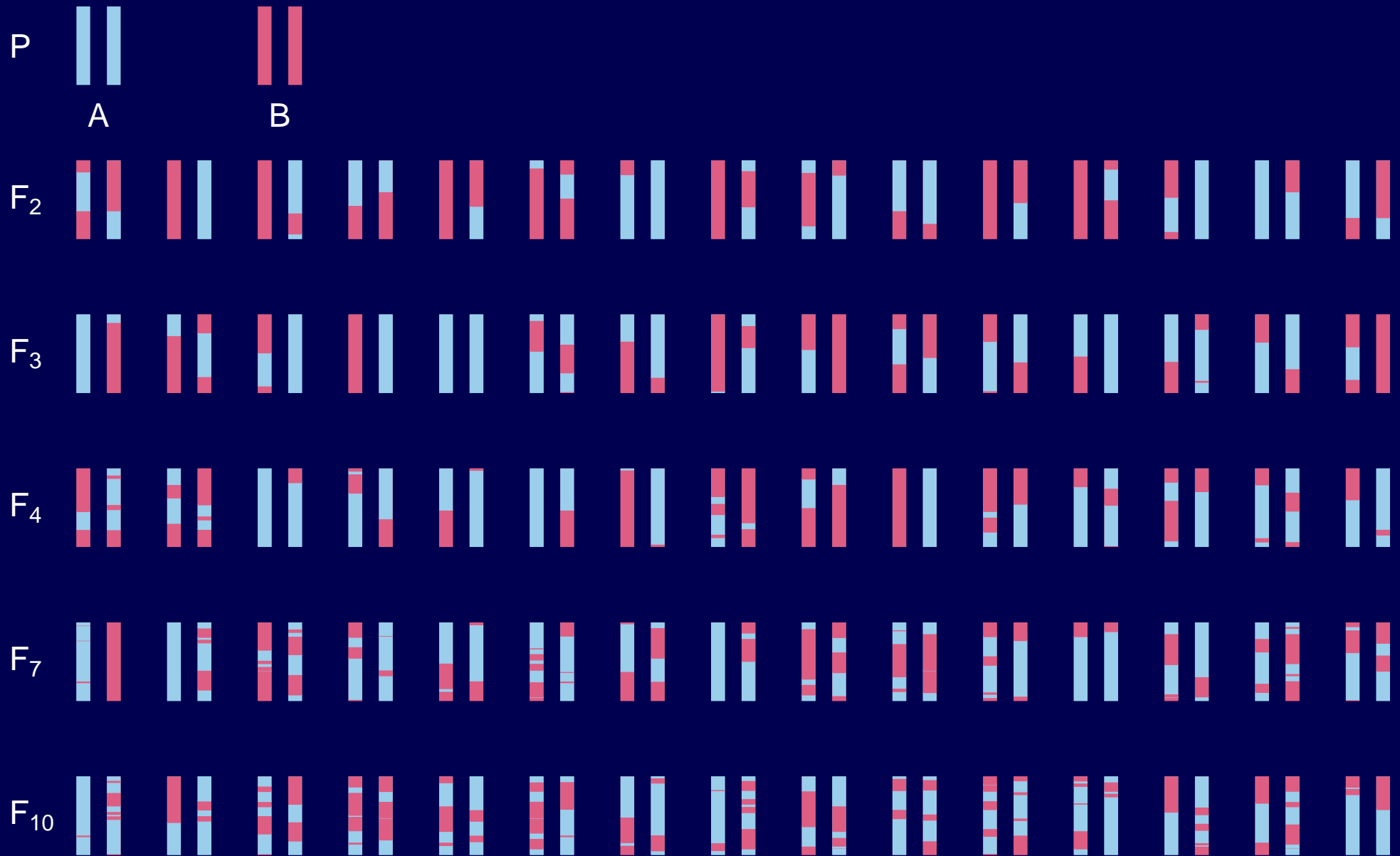
# Congenetic line / NIL



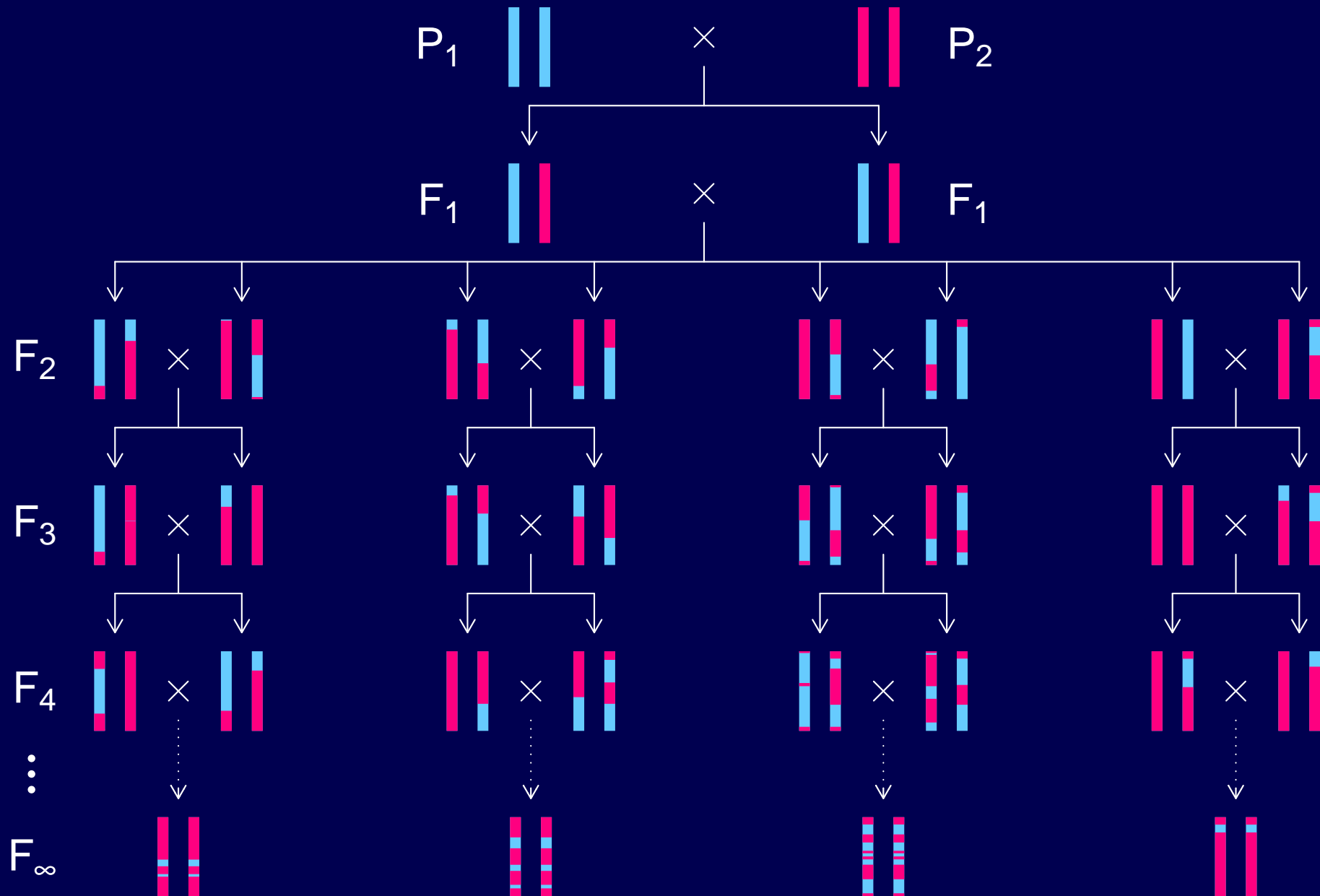
# Improving precision

- more recombinations
- more individuals
- more precise phenotypes
- lower-level phenotypes  
transcripts, proteins, metabolites

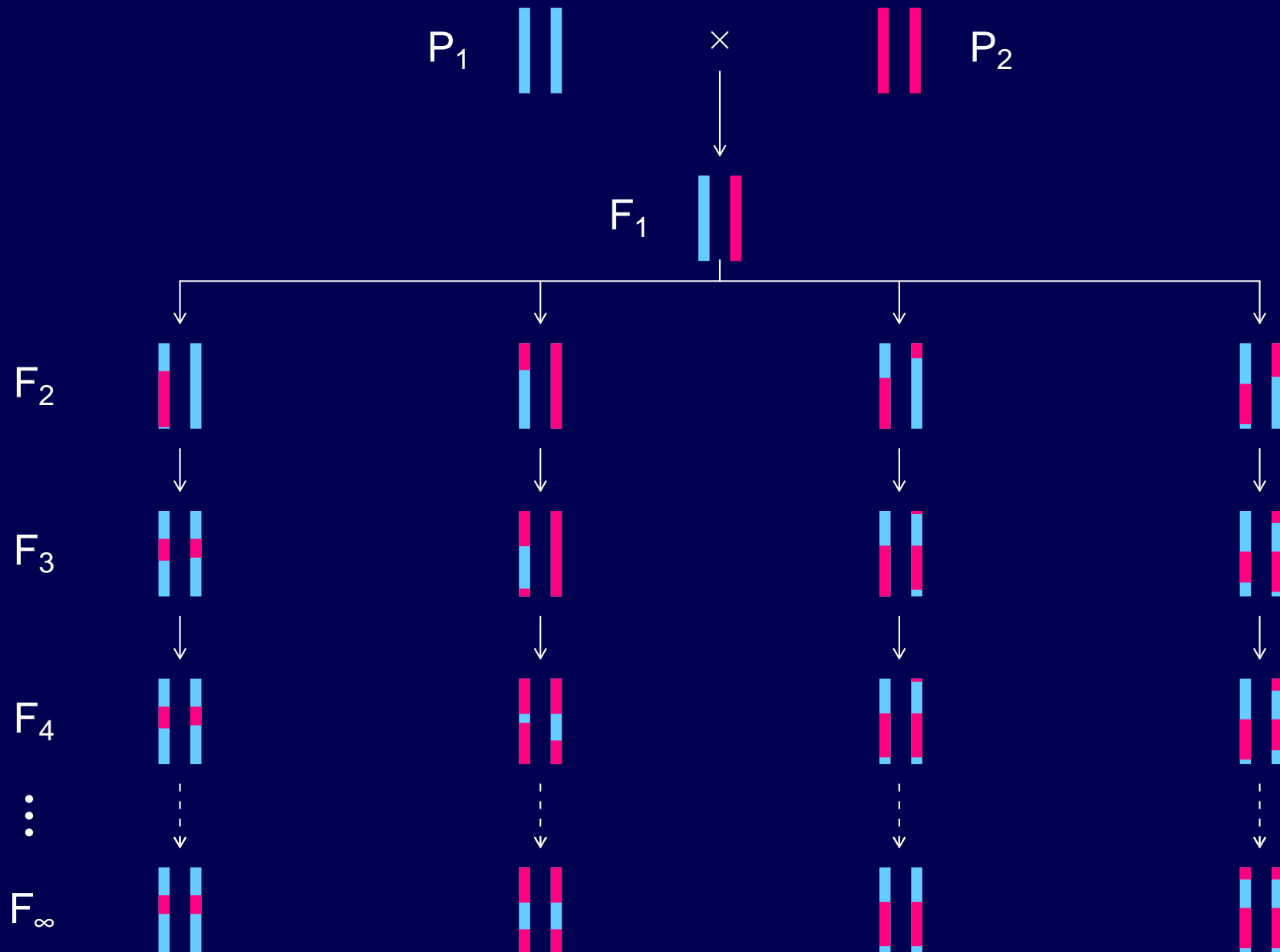
# Advanced intercross lines



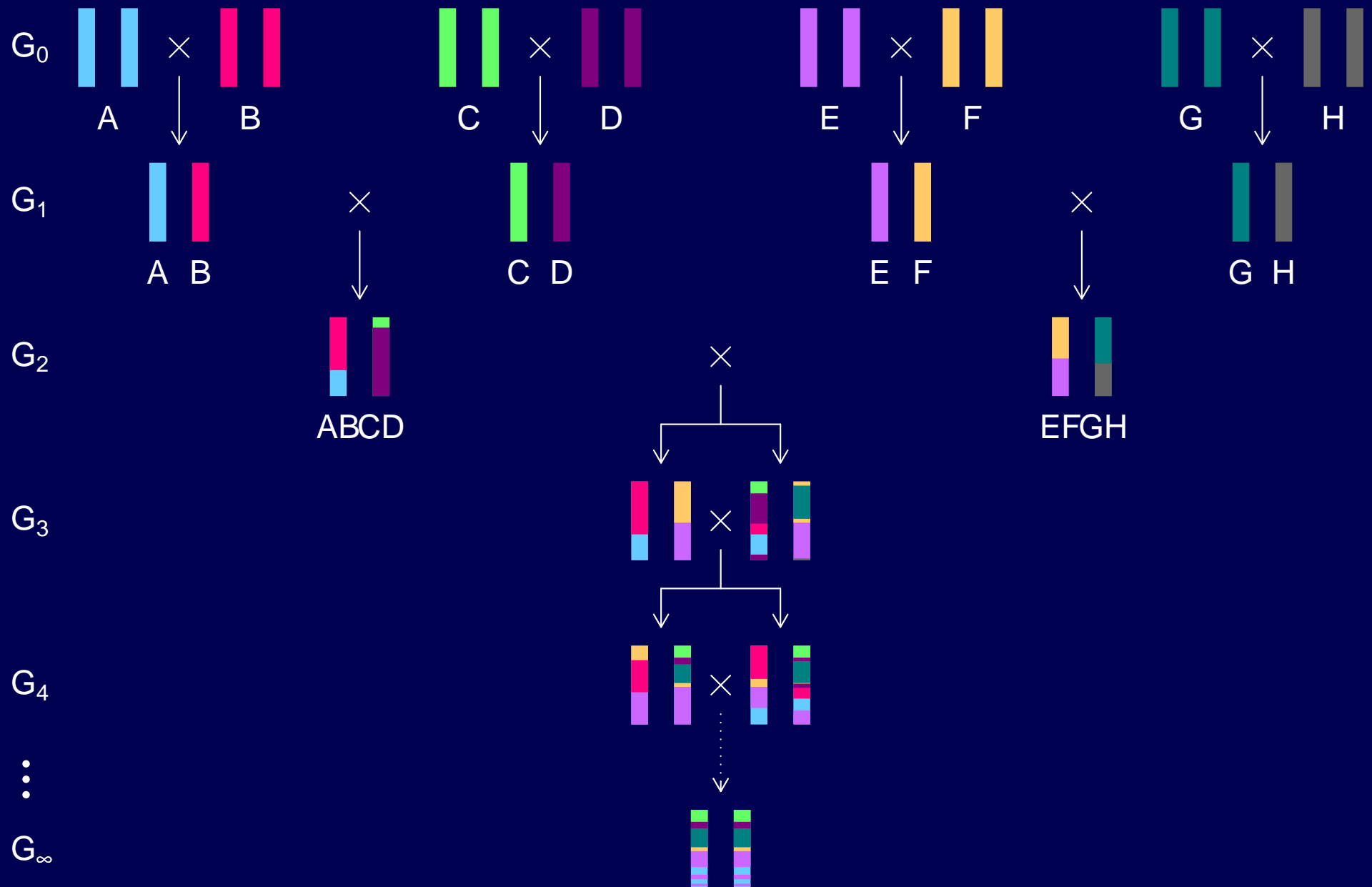
# Recombinant inbred lines



# Recombinant inbred lines

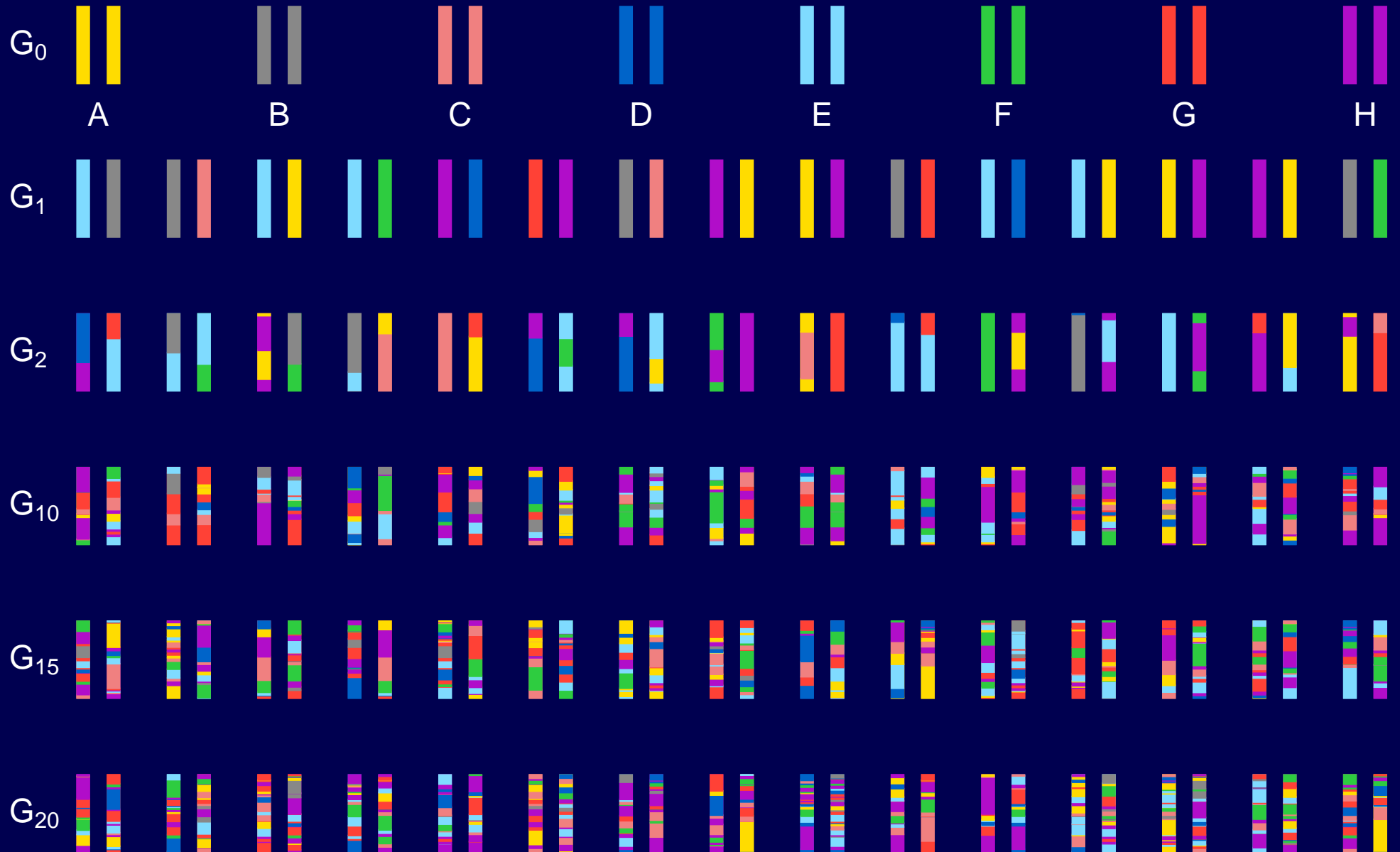


# Collaborative Cross/MAGIC





# Heterogeneous stock



# Why R/qtl2?

- High-dimensional data  
genotypes and phenotypes
- More diverse crosses  
especially multi-parent populations
- Linear mixed models  
especially in DO/HS/AIL

# R/qtl → R/qtl2

- See [kbroman.org/qtl2/assets/vignettes/rqtl\\_diff.html](http://kbroman.org/qtl2/assets/vignettes/rqtl_diff.html)
- New data file formats
- New data structures
- New function names

`read.cross()` → `read_cross2()`

`calc.genoprob()` → `calc_genoprob()`

`scanone()` → `scan1()`

- Different treatment of intermediate calculations
- Use of individual IDs for aligning data
- Order of args when subsetting cross objects

`cross[chr,ind]` → `cross2[ind,chr]`

→ R

- `convert2cross2()`
- `summary()`, `n_ind()`, `n_mar()`, ...
- `insert_pseudomarkers()`
- `calc_genoprob()`
- `scan1()`
- `find_peaks()`

# Linear mixed models

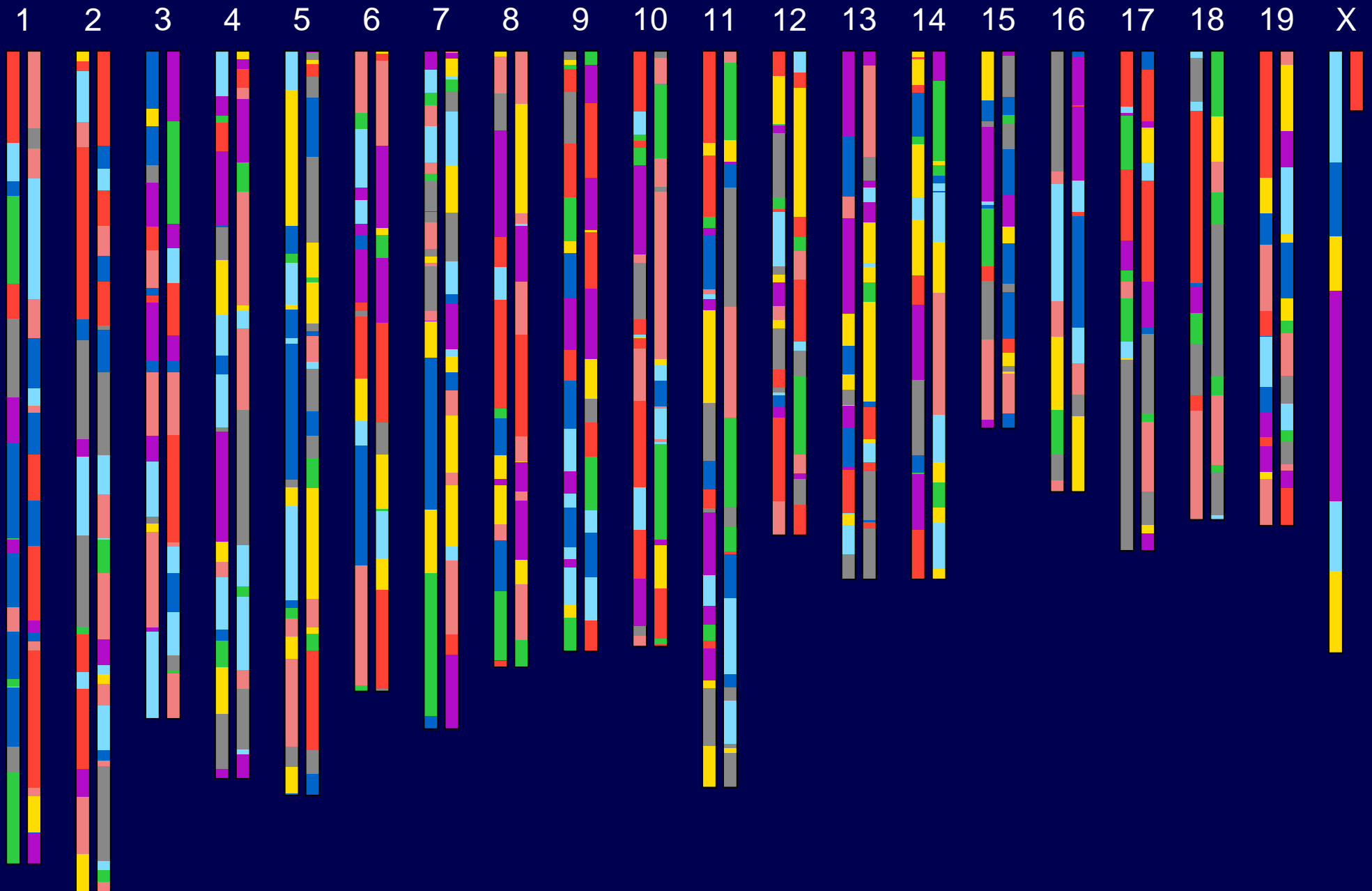
$$\begin{aligned} y_i &= \mu + \sum_k \beta_k q_{ik} + \epsilon_i & \epsilon_i &\sim \mathbf{N}(0, \sigma_e^2) \\ &= \mu + \eta_i + \epsilon_i & \eta_i &\sim \mathbf{N}(0, \sigma_p^2) \end{aligned}$$

$$\mathbf{COV}(\eta_i, \eta_j) = \sigma_p^2 (2k_{ij})$$

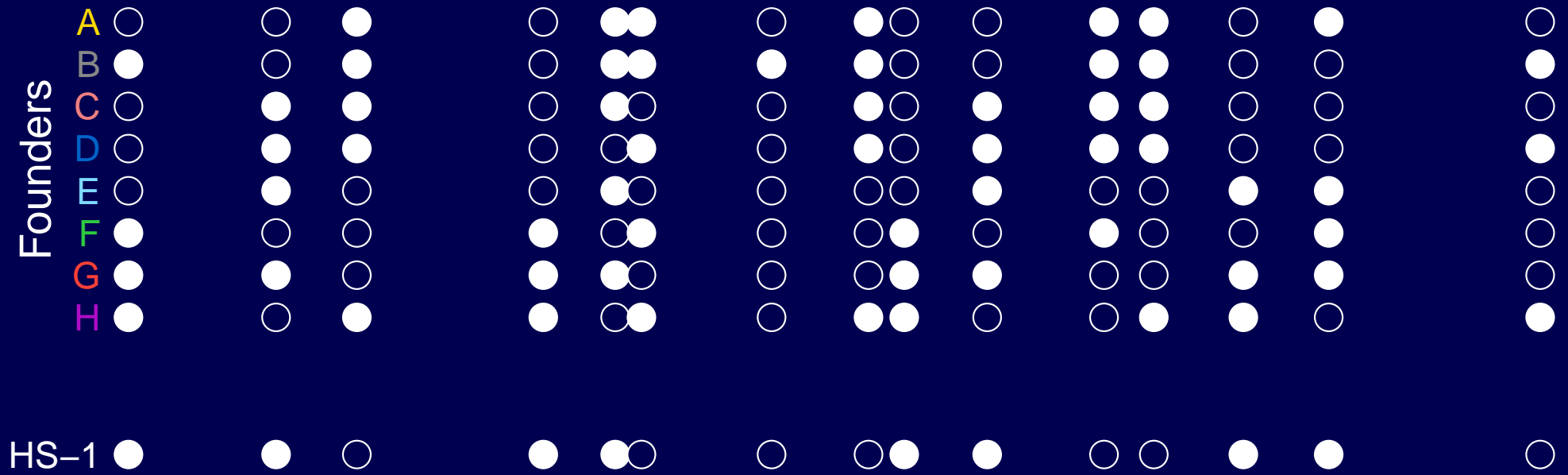
→ R

- `calc_kinship()`
- `scan1()`

# HS genome

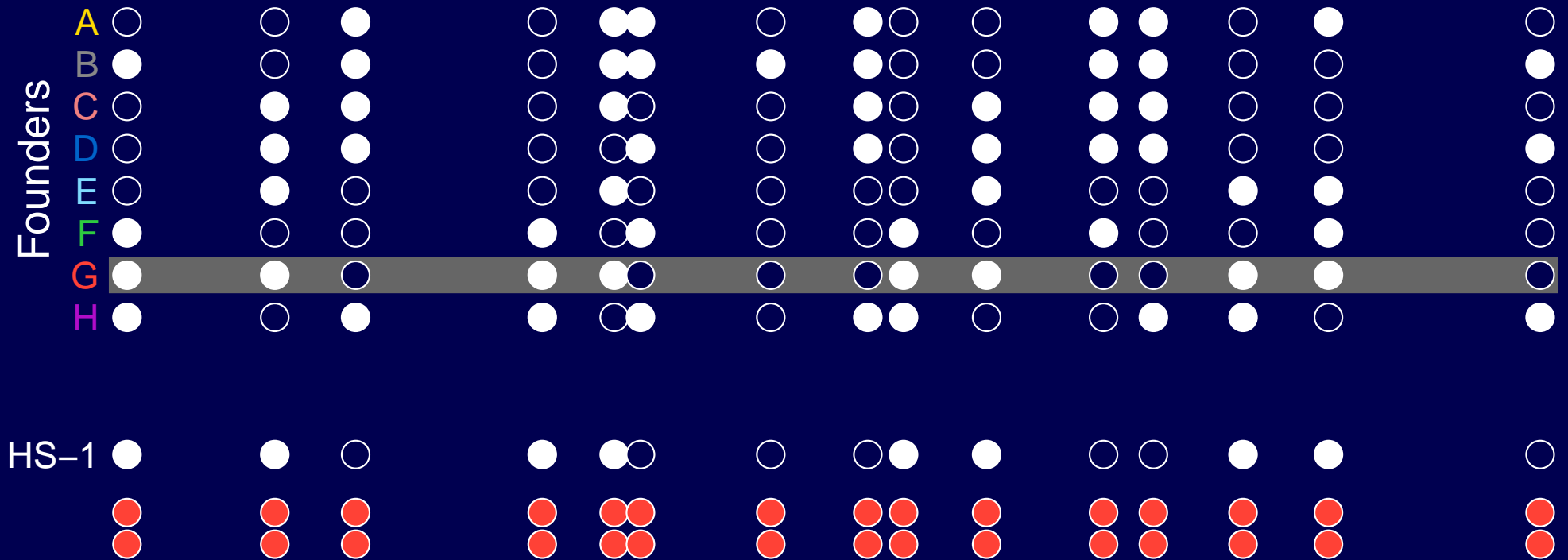


# HS genotype reconstruction

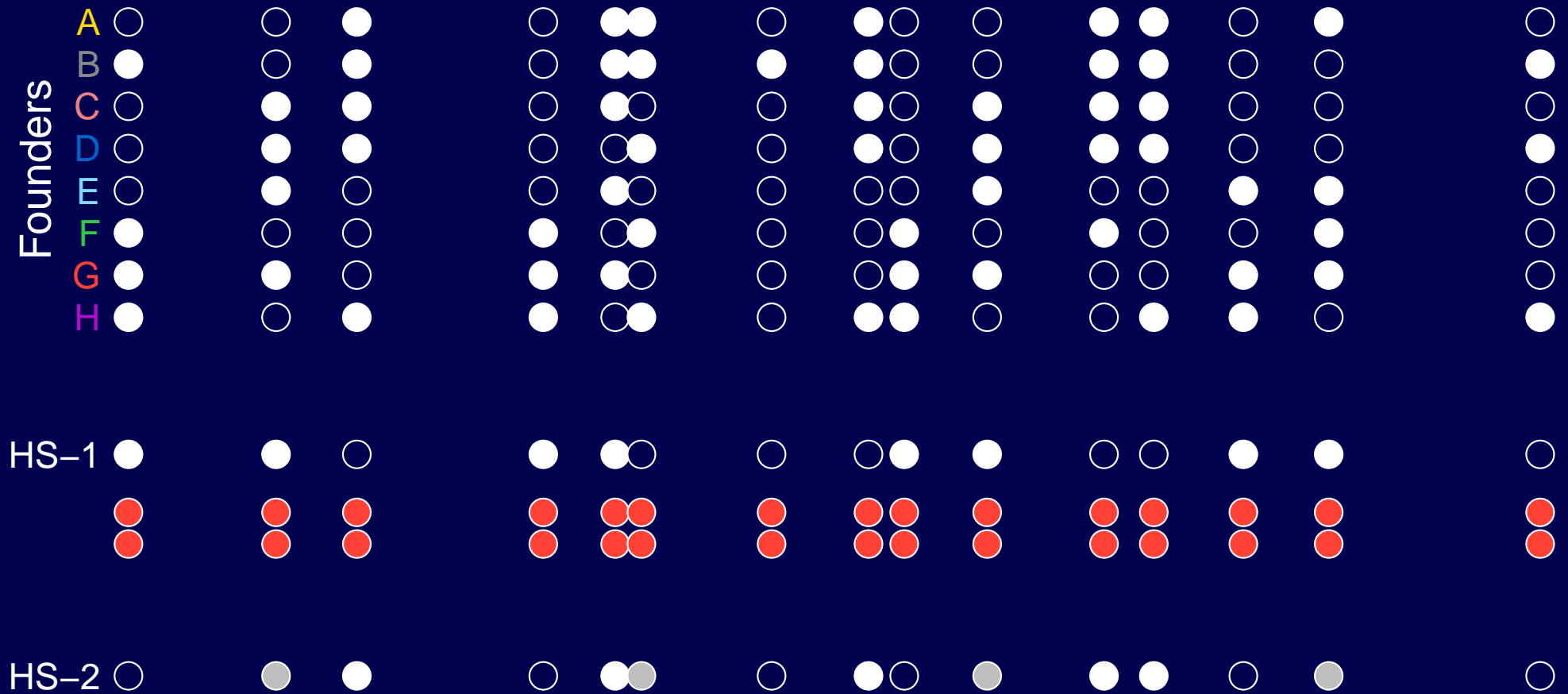




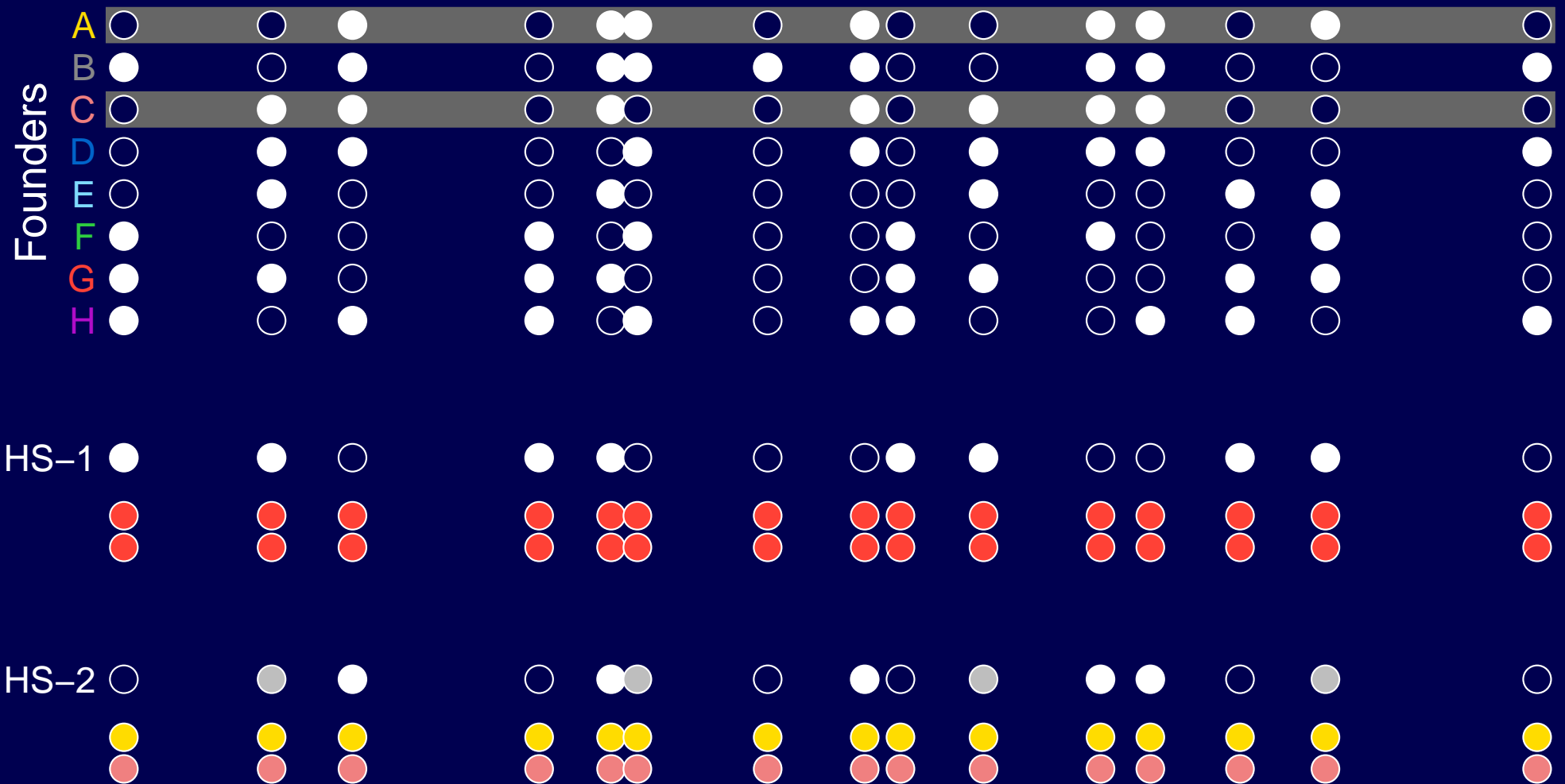
# HS genotype reconstruction



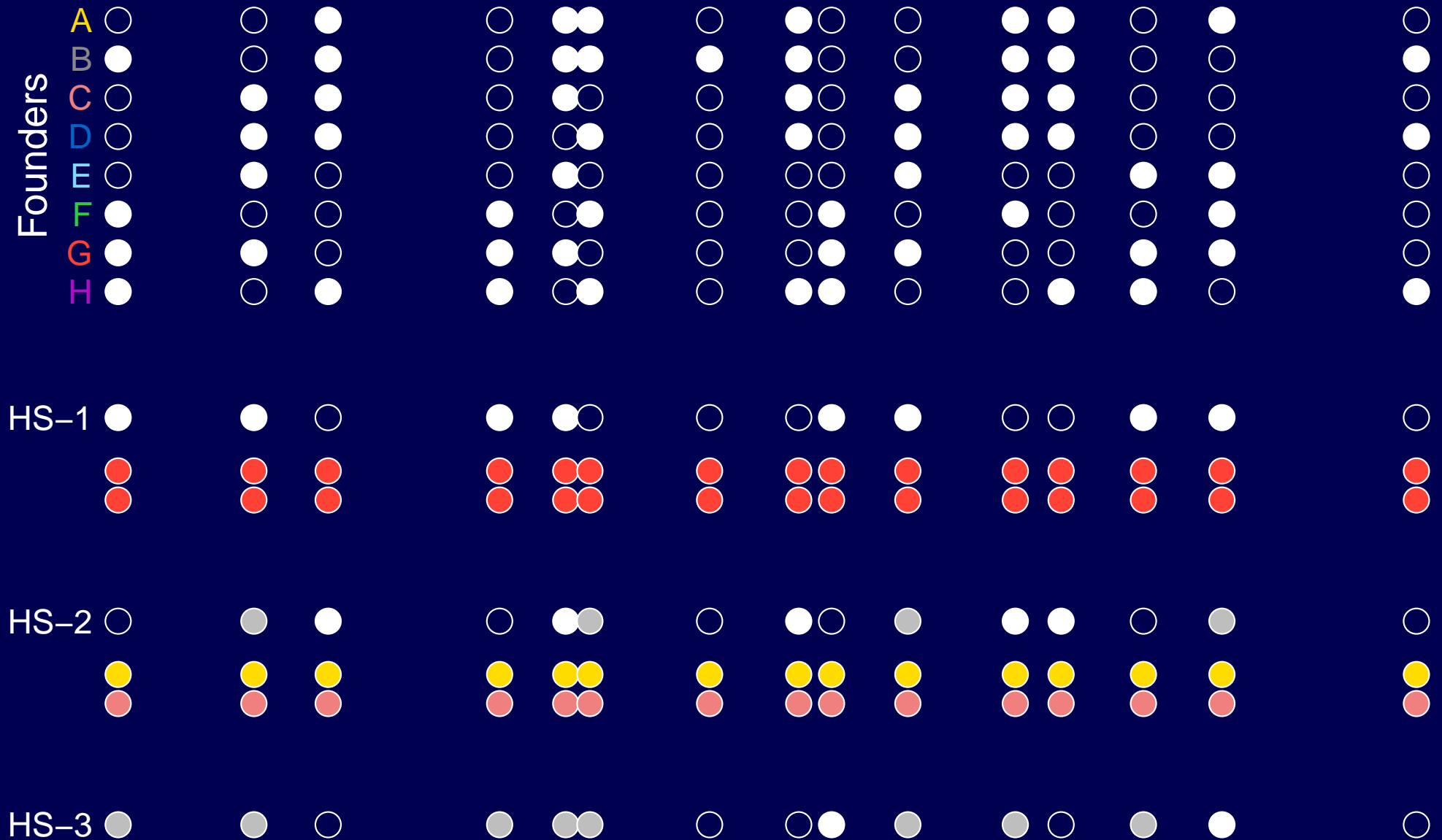
# HS genotype reconstruction



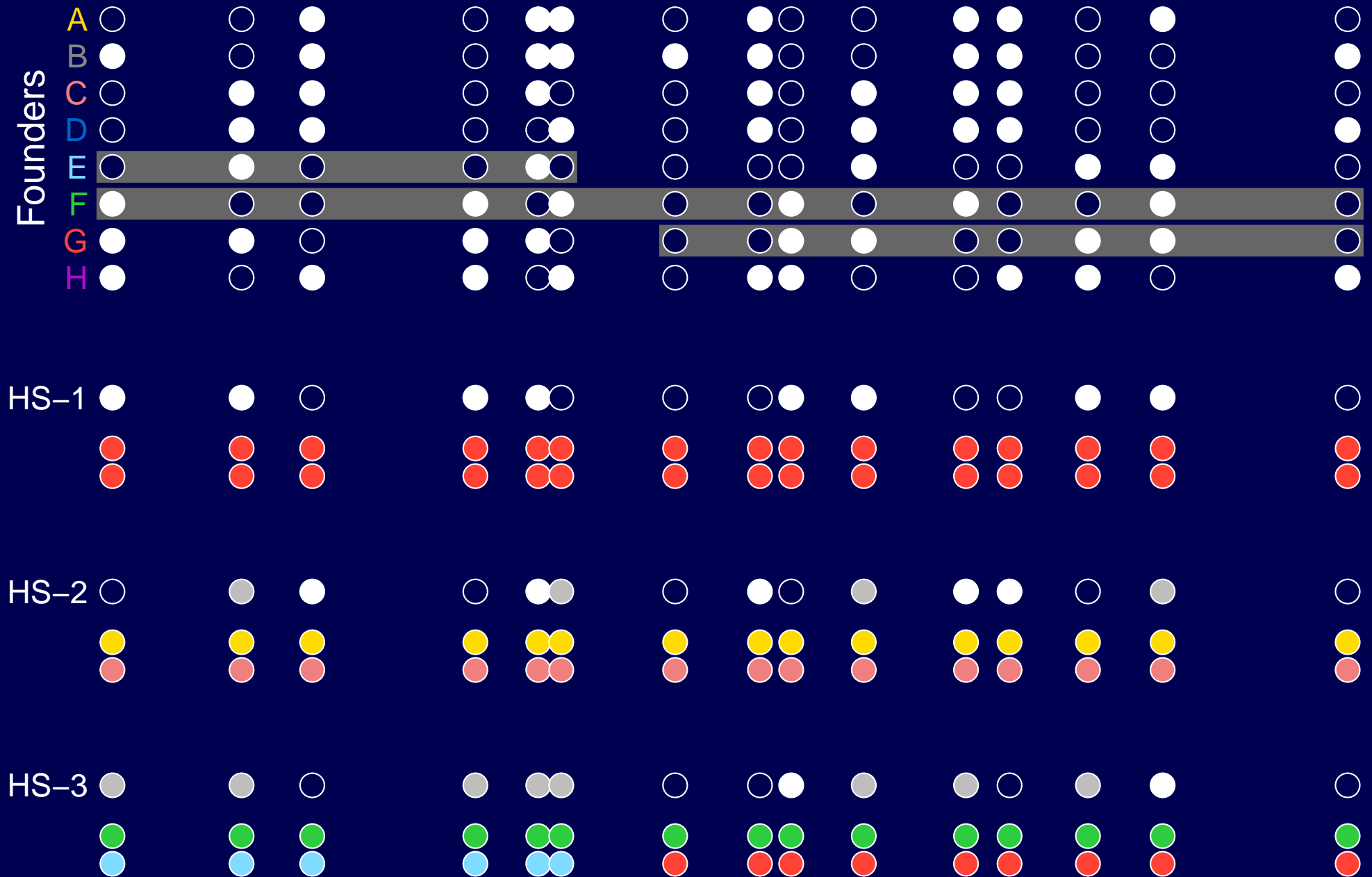
# HS genotype reconstruction



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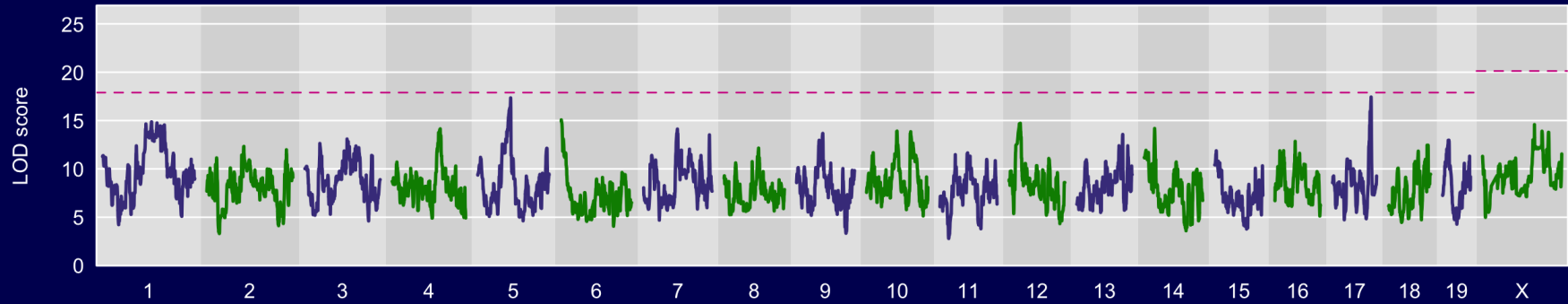


# HS genotype reconstruction

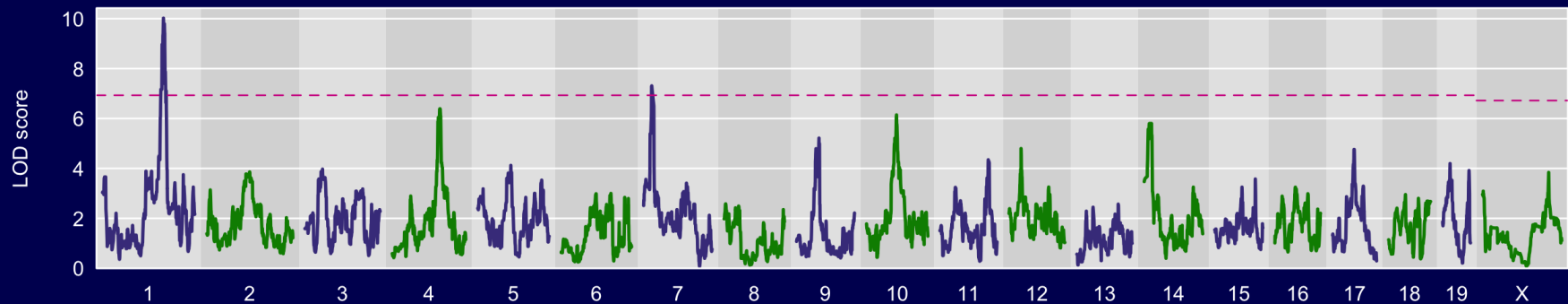


# Genome scans

Full model



Additive alleles



SNP associations

